Poster I-61

Cellular Automata Model for Limb Chondrogenesis Based on Reaction-Diffusion and Cell-Matrix Adhesion

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Developmental patterning; the establishment of non-uniform, nonrandom arrangements of different cell types within tissue masses, results from an interplay of changing gene expression and physical changes. Computational models, which can organize and integrate over time vast numbers of molecular interactions and cell behavioral changes, are ideal to represent such complex dynamics.

This poster focuses on a discrete, lattice-based CA model for behavior of limb bud precartilage mesenchymal cells undergoing chondrogenic pattern formation. In our "agent-oriented" CA model, cells are represented by points on a lattice and are assigned simple rules motivated by experimental findings. The rules include random cell motion, production and lateral deposition of a substratum adhesion molecule (SAM), production and release of a diffusible growth factor ("activator") that stimulates production of the SAM, and another diffusible factor ("inhibitor") that suppresses the activity of the activator. Parameters are identified for which the system exhibits nodular patterns that resemble those of leg cell cultures, including number, distribution and spacing of cell condensations. This reference system was then studied experimentally, including subjecting it to cell dilution, transient exposure to exogenous activator, suppression of inhibitor, and constitutive activation of SAM production. There was good correspondence between in silico and in vitro experimental results.

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